

Transvenous Treatment of a Dural Arteriovenous Fistula of the Transverse Sinus by Embolization with Platinum Coils and Onyx HD 500+

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Summary

We report the endovascular treatment of a symptomatic dural arteriovenous fistula in a 61-year-old male patient. The medial portion of the fistula was occluded with detachable platinum coils during an initial intervention using a transvenous approach. Due to persistence of the symptoms in a second intervention eight months later the fistula was completely occluded by the transvenous introduction of a liquid embolic agent (Onyx 500+). The liquid embolic agent was introduced under protection by the temporary balloon occlusion of the fistula's venous drainage. After the procedure, the patient was treated for three months with 75 mg clopidogrel (Plavix®) and with 100 mg acetylsalicylic acid (ASS®). A few days after the intervention, the patient was discharged without any neurological deficit and in good clinical condition. The follow-up examination six months later neither detected a recurrence of the dural arteriovenous fistula in the angiogram nor any neurological symptoms.

Introduction

Dural arteriovenous fistulas (DAVF) or malformations (DAVM) are abnormal arteriovenous shunts in the dura mater that comprise 10

to 15% of all arteriovenous malformations (AVM)¹. A DAVF can affect any section of the dura mater fundamentally². As in our case, the region of the transverse and sigmoid sinus is the most frequent location³. Different classifications of the DAVF are described: The most frequently used that one of Merland and Djindjian⁴, validated and modified according to Cognard⁵. This classification considers a DAVF as belonging to one of five types (type I to V) based on its venous drainage and flow direction.

The conventional endovascular treatment of a high-flow DAVF with or without cortical venous drainage consists of transarterial, transvenous or combined embolization in order to completely occlude the fistula points^{3,6}. Transarterial embolization is primarily performed with liquid or particle embolization⁷⁻¹³. Detachable platinum coils are primarily used in transvenous approaches^{3,14,15}. Although the medical literature confirms that the method of transvenous access and occlusion has a high obliteration rate in DAVFs and the curative successes in the treatment of this disease have increased because of this, the complete endovascular occlusion of the fistula points can be technically difficult or impossible to achieve¹⁶. The objective of the present case demonstration is the description of a successful, transvenous, endovas-

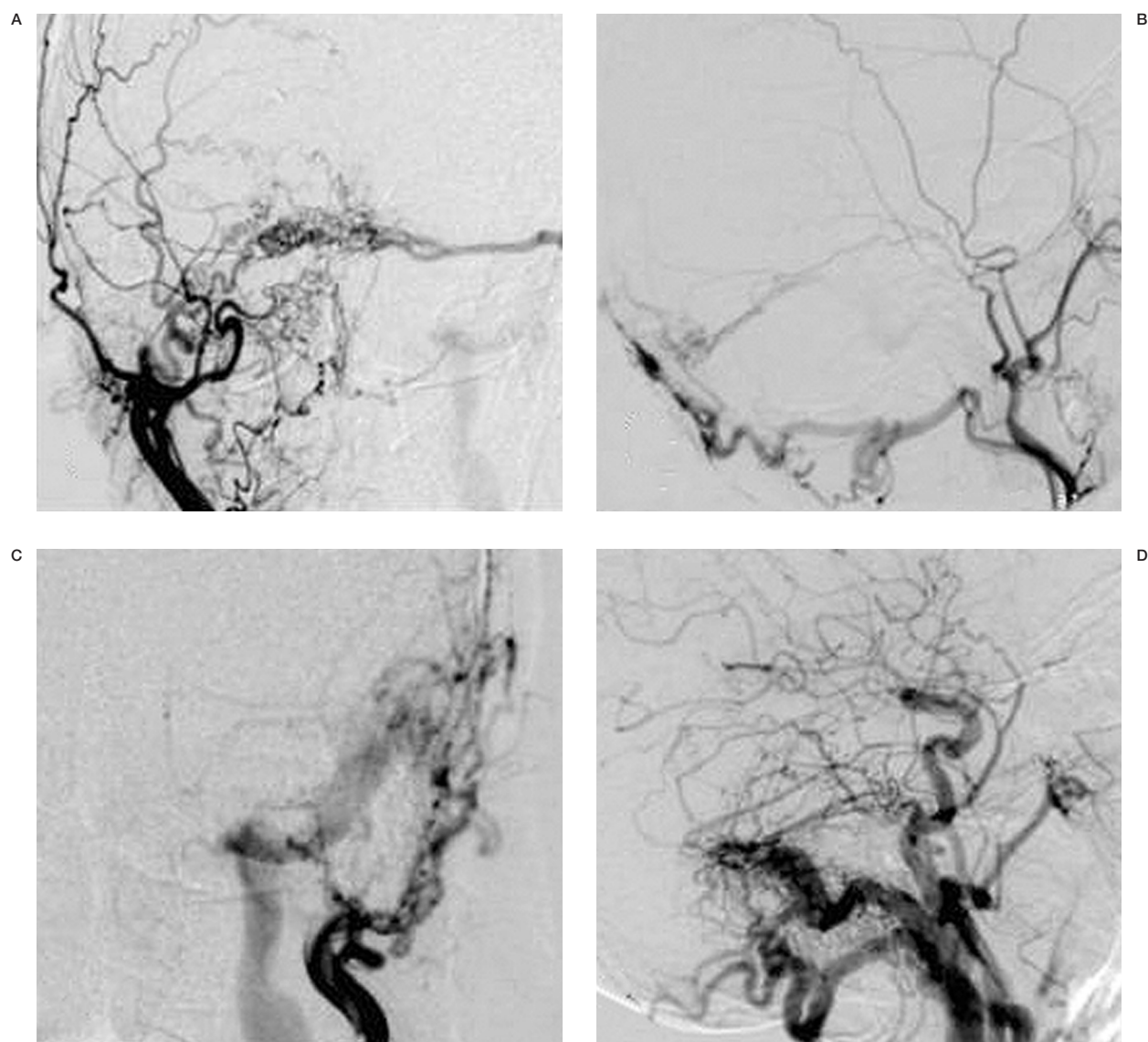


Figure 1 Angiogram of the right (A,B) and left (C,D) external carotid arteries (ACE) in Towne projection and lateral view. Depiction of the fistula channel consisting of multiple sources of inflow from the right ACE until the channel opens into the left transverse sinus. Multiple sources of inflow from the left ACE with a direct opening into the lateral transverse sinus.

cular treatment of a type I DAVF through the combined use of platinum coils and Onyx HD 500+.

Case

The 61-year-old male patient had complained of increasing pulsatile tinnitus since three months. The patient did not exhibit any neurological symptoms except for an extremely bothersome ear noise which was not auscultable.

The preinterventional angiogram showed an arteriovenous fistula with multiple inflows from both external carotid arteries and a venous drainage to the left transverse sinus. This corresponded to a type I DAVF according to the classification of Cognard (figure 1). During the first intervention, a channel in the wall of the left transverse sinus, running parallel to the sinus and opening into it, was probed transvenously from an ipsilateral orientation and then occluded with platinum coils extending all the way into the transverse sinus. This part of the

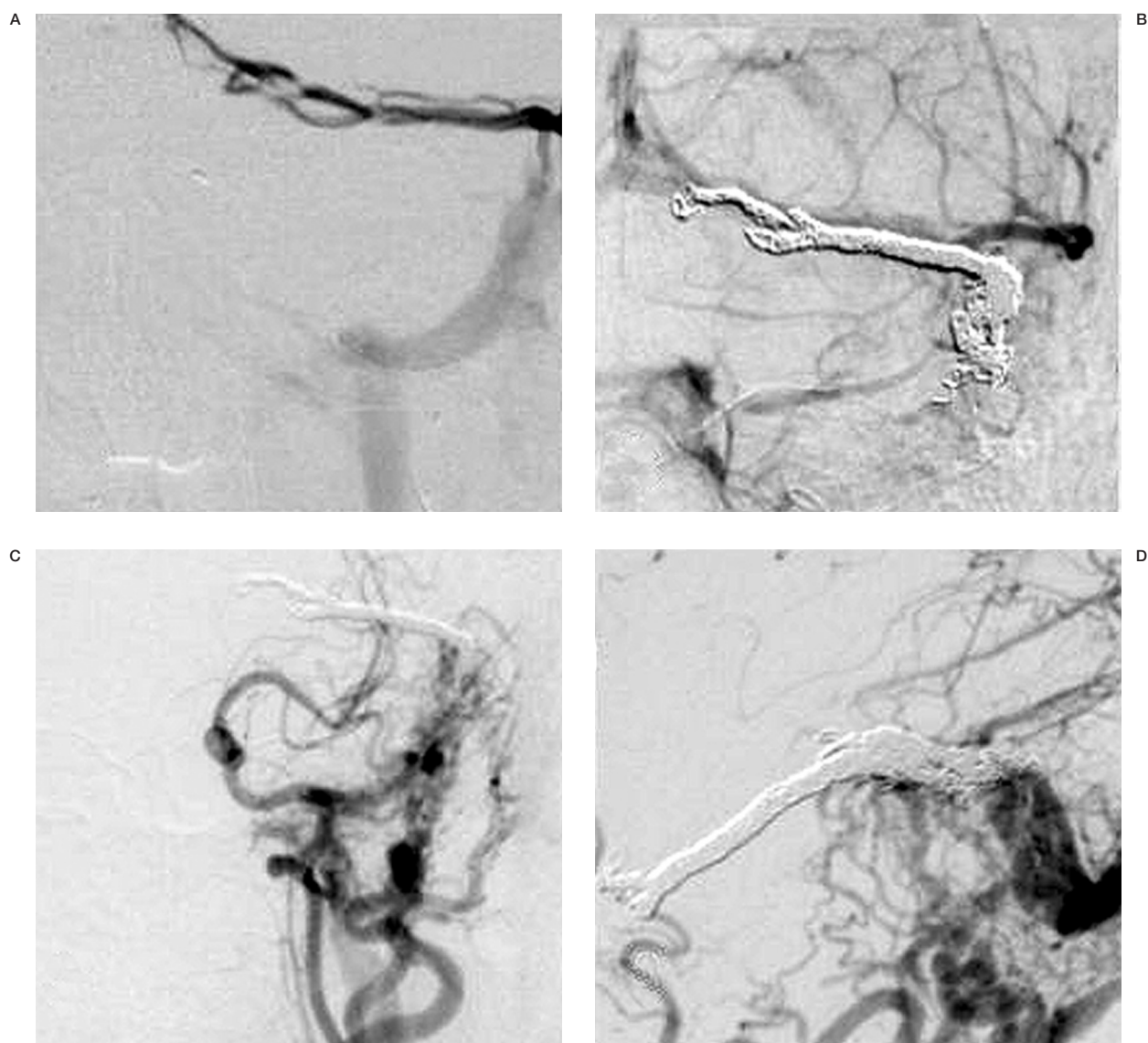


Figure 2 A) Selective depiction of the fistula channel in a.p. projection after probing with the microcatheter and retrograde contrasting of the lateral transverse sinus. B) Angiogram of the right ACE in Towne projection. Occlusion of the fistula channel with platinum coils until the lateral transverse sinus. C,D) Angiogram of the left ACE in Towne and lateral projection. Multiple arterial sources of inflow out of the left ACE with direct drainage into the distal transverse sinus.

fistula was supplied by the right external carotid artery (figure 2). Because of the persistence of the symptoms in a second intervention eight months later that employed protection via a temporary balloon occlusion (Hyperform 7x7 mm, Micro Therapeutics, Irvine, CA, USA) at the level of the left sigmoid sinus, the transverse sinus was transvenously occluded with a liquid embolic agent, Onyx HD 500+ with 20% copolymer component (Micro Therapeutics, Irvine, CA, USA) (figure 3).

The embolic agent was injected through a DMSO-compatible microcatheter (Titan, Micro Therapeutics, Irvine, CA, USA). Before starting the embolization, a contrast medium was injected through the microcatheter while the balloon was inflated to document the complete interruption of venous drainage (seal test). Over a time period of 21 minutes a total of 0.75 ml Onyx HD 500+ was introduced intermittently during 12 injection intervals of varying length. The final angiography documented the comple-

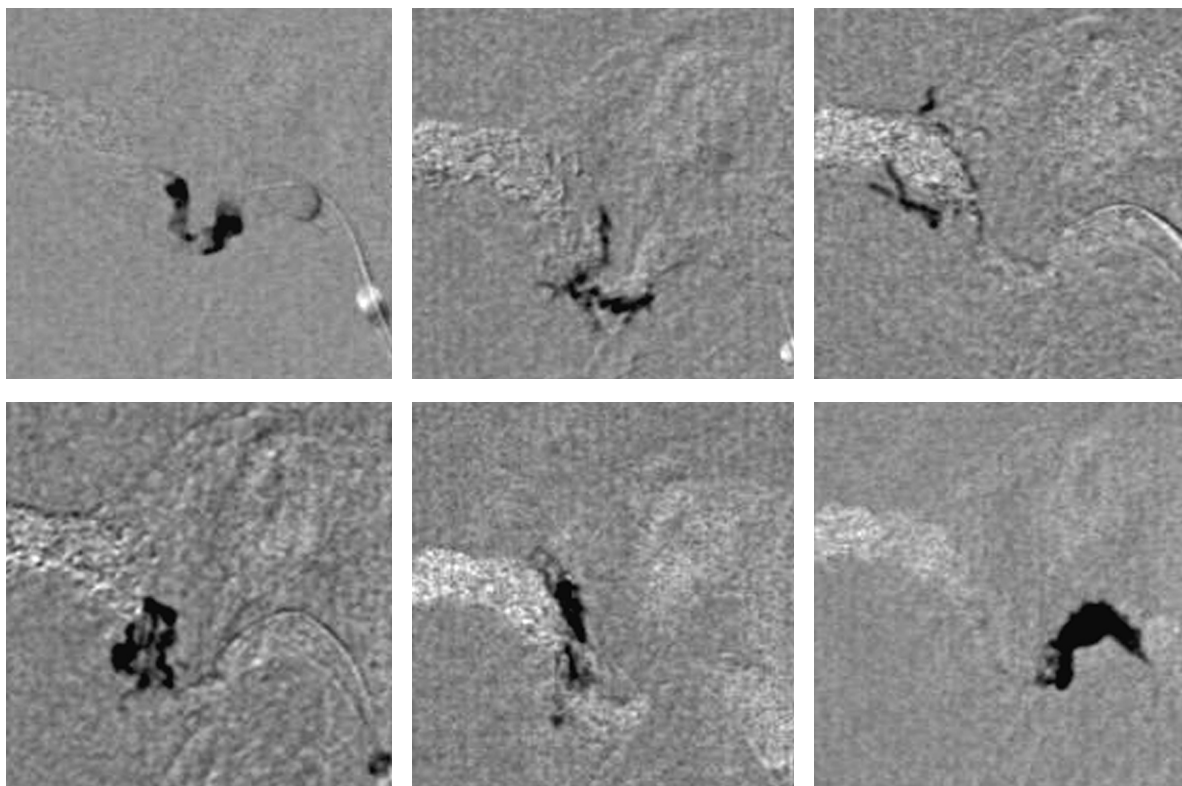


Figure 3 Injection of Onyx 500+ under temporary balloon occlusion of the lateral transverse/sigmoid sinus. Filling and occlusion of the transverse sinus as well as the afferent fistula channels in the sinus wall with Onyx 500+.

te occlusion of the DAVF (figure 4). Over a period of three months the patient was treated with 75 mg clopidogrel (Plavix®) and with 100 mg acetylsalicylic acid (ASS®) due to the antiplatelet regimen in the treatment of intracranial aneurysms with Onyx HD 500+. Transarterial angiography of all intracranial blood vessels six months after treatment confirmed the permanence of the occluded fistula. Regarding the neurological status, the patient was neurologically asymptomatic after this time period.

Discussion

During the past few years, the medical literature on the therapy of arteriovenous, intracranial^{17,18} and intraspinal malformations^{19,20} as well as the treatment of intracranial aneurysms²¹⁻²³ has increasingly reported the use of a new liquid embolic agent. This substance is an ethylene vinyl alcohol copolymer that is dissolved in dimethyl sulfoxide (DMSO) and to which tantalum has been added for radiological visibility (Onyx, Micro Therapeutics, Irvine, CA, USA).

To our knowledge there are not yet any reports in the medical literature concerning the treatment of a DAVF of the transverse sinus with this liquid embolic agent.

Compared with the introduction of platinum coils, liquid embolic agents present several advantages and disadvantages fundamentally. On the one hand, the great depth of penetration and the homogeneous filling of the cavity to be occluded are decisive advantages of liquid embolic agents when compared with detachable platinum coils. On the other hand, the undesirable proximal or distal spreading of the embolization material is a possible complication during liquid embolization^{23,24}. Therefore, the embolization should only be performed using a protective balloon occlusion. Compared with N-butyl-2-cyanoacrylate (NBCA), Onyx exhibits advantages: a milder inflammatory tissue reaction^{25,26,27}; good controllability because of its extremely slow injection and the larger injection volume because multiple injection cycles were possible.

To achieve a gap-free and homogeneous filling of the venous drainage spaces of the DAVF

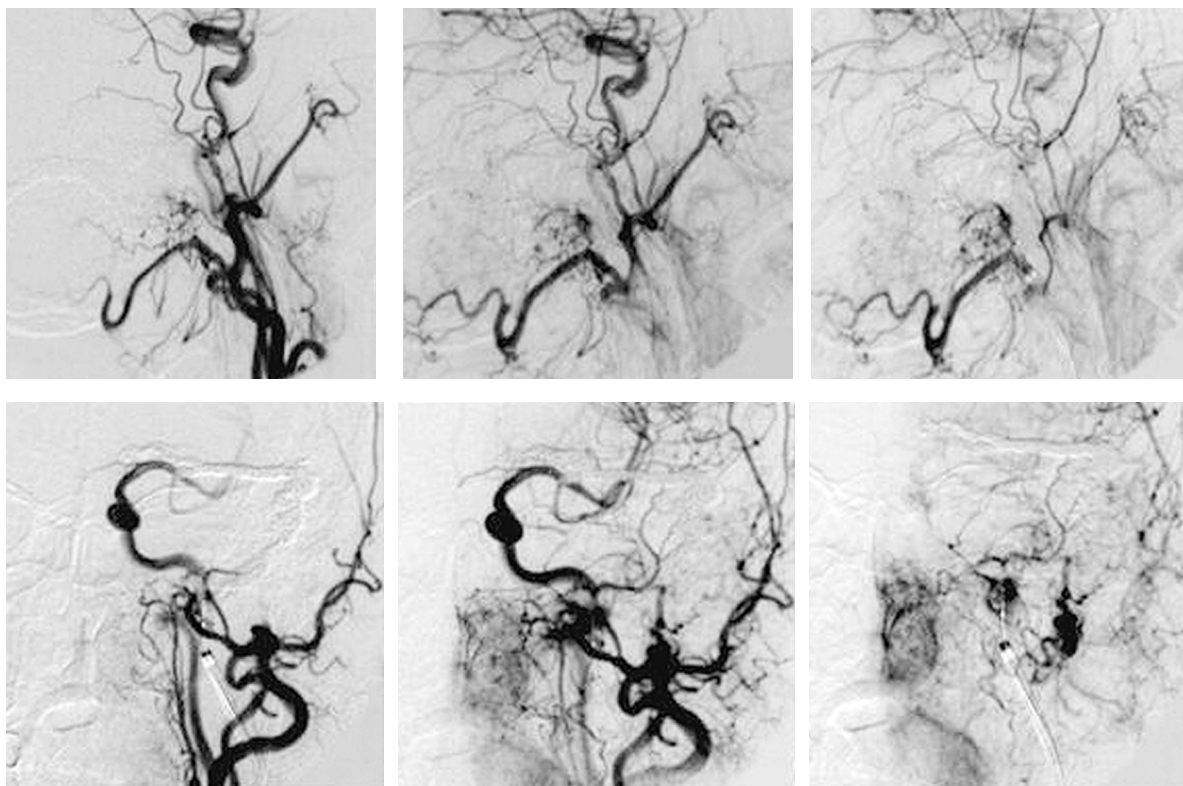


Figure 4 Final angiogram of the left common carotid artery in frontal and lateral projections. Demonstration of the occlusion of the DAVF.

in our demonstrated case, we used the embolic agent with the currently highest available copolymer component of approximately 20%, namely Onyx HD 500+, which is also used in the endovascular treatment of aneurysms. In the described case the DAVF was occluded by the consecutive use of platinum coils and Onyx 500+ in two treatment sessions. As a result of the primary occlusion of the venous fistula channel and the bordering transverse sinus with platinum coils along the medial or distal course, it was possible to treat the lateral or proximal portion of the transverse sinus and the fistula by means of proximal balloon occlusion during a second intervention. The question of whether the sole use of the liquid embolic agent would have yielded the same result or even have proven advantageous presently cannot be answered yet. Also if and what antiplatelet regimen in such cases is necessary seems to be open and can not be answered in the moment. The results from the treatment of larger patient collectives is needed. Currently the sole use of Onyx to occlude the transverse

sinus requires a proximal and distal temporary occlusion which significantly increases the level of technical difficulty of the intervention. For this reason, further technical developments of Onyx with a significantly higher copolymer component are arbitrary because they may permit the use of this embolic agent without balloon protection.

Conclusions

The endovascular treatment of a DAVF located in the transverse and sigmoid sinus is often a combination of transarterial and transvenous access that mainly employs particle embolization and detachable platinum coils. In addition to these techniques the use of a liquid embolic agent such as the ethylene vinyl alcohol copolymer of high density (Onyx 500+) is an interesting and promising supplementation of the previously used materials. We demonstrated the successful transvenous use of a combination of platinum coils and Onyx to occlude a DAVF of the transverse sinus.

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